

A Novel Computer Interface for Echocardiographic Reporting

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Background. The form and structure of a computer interface are critical factors in its usability and in the efficiency of the resulting data entry and data review processes. The challenge of interface design is to encapsulate the relationships in a data set and the patterns in order to streamline the users' interaction with the data to create data entry and review processes that are logical and efficient.

Medical test report generation systems present an interface design challenge. Unlike medical applications based on large and poorly structured data sets, report generation systems focus on more organized data sets with limited domains. User expectations for such systems are high due to an awareness that the interface determines the time and effort that it takes to produce a report.

System. We have developed an interface for echocardiographic report generation that incorporates several novel fundamental elements: (i) the interface encapsulates the natural right-left symmetries in cardiac structure to maximize the amount of information that can be displayed on a single screen, (ii) the interface includes a unique, compact, custom control to standardize the input and review of semi-quantitative echocardiographic data, and (iii) the interface is constructed to support the rapid comparison of longitudinal data as the natural by-product of the data entry process.

In this interface, cardiac structures are grouped as left-right pairs (e.g., the left and right ventricles) that share common data descriptors (e.g., ventricular size and function) and, in many cases, common data input tools for entering information regarding these descriptors. The descriptors are positioned centrally within each display element, and the data values for each descriptor are positioned to the left and right. The user activates entry of information related to a particular cardiac structure by selecting the left or right counterpart from the appropriate structure pair. The data input tools are then set to apply to that structure. For example, if the user specifies the left ventricle, then the ventricle data input tools are set to accept left ventricle data values. This setting is

communicated to the user through visual cues (highlighting and greying out) that signal which structure is currently active for data input. Taking advantage of cardiac symmetries in this manner makes it possible to display on a single main screen nearly half of the over 500 findings used in a structured echocardiographic report. Visual cues are also provided to signal the presence and type of information available within a limited number of subordinate (nested) windows.

Semi-quantitative echocardiographic data (e.g., chamber size and degree of valvular regurgitation) are displayed using an extremely compact custom control consisting of a set of buttons that activate a parallel set of lights. Reuse of this custom control allows comments on semi-quantitative data to be standardized, which facilitates data entry and review through habituation. A standard semi-quantitative color scheme also allows a user to easily locate abnormal findings anywhere on the interface.

Longitudinal comparison of data is supported by displaying two values for each finding: the value from the current study and the value from the last study done on a patient. The semi-quantitative data control, for instance, uses two parallel sets of lights for each finding. The spatial layout of these values is used to communicate their temporal relationship. The innermost value (that closest to the associated input tool) corresponds to the current study, while the outermost value corresponds to the previous study. This same spatial layout scheme is applied throughout the interface. Presenting longitudinal information in a visually coherent manner allows a user to rapidly evaluate how the information currently being entered relates to previously entered findings.

Conclusion. This system has been in continuous use in a busy adult echocardiography lab (25-35 studies/day) since November 1996. The system has re-engineered the process of echocardiographic results reporting, and enjoys a high level of user acceptance.